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# Overlap Areas of a Square Box on a Square Mesh

by James U Cazamias

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## 1. Objective

To aid in a data-reduction process, an algorithm was generated to calculate on a square mesh (elements with sides of length  $2m$ ) the area of overlap for individual elements with a square box (sides of length  $2n$ ) that is not rotated relative to the mesh subject to the constraint  $n < 2m$ .

## 2. Algorithm

Ignoring edge elements, we can assume the following construction (Fig. 1) without loss of generality: 1) a  $3 \times 3$  mesh with the coordinate system's origin at the center of the middle element and 2) a square box with center  $(x,y)$ , which also lies in the middle element. The constraint ensures that the box lies entirely within the  $3 \times 3$  mesh. We label the elements  $(i,j)$  with  $i,j = 1,2,3$ . We define the overlap area of an individual mesh element  $(i,j)$  with the box as  $A_{ij}$ . Since the box is not rotated relative to the mesh, notice that the overlap areas are rectangles with sides  $\Delta x_i$  and  $\Delta y_j$  with

$$A_{ij} = \Delta x_i \Delta y_j. \quad (1)$$

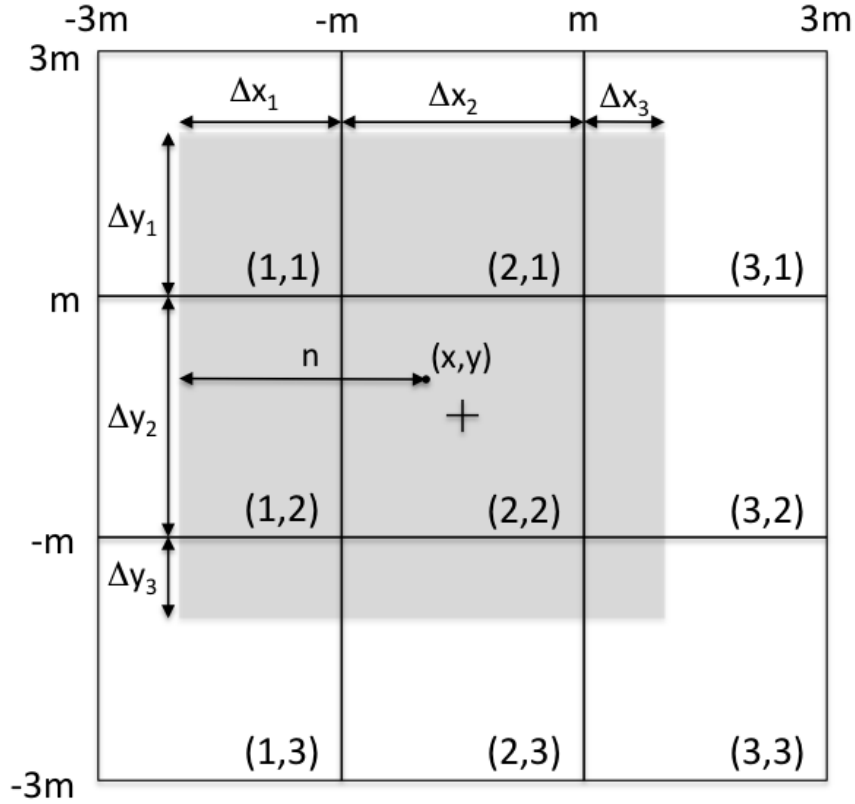


Fig. 1 Construction geometry

The terms  $\Delta x_2$  and  $\Delta y_2$  will always be nonzero, but we need to check if  $\Delta x_1$ ,  $\Delta y_1$ ,  $\Delta x_3$ , and  $\Delta y_3$  are nonzero as well. The terms  $\Delta x_i$  and  $\Delta y_j$  are determined using Table 1 and Eqs. 2 and 3.

**Table 1 Construction definitions**

<b>If</b>	<b>Then</b>	<b>Else</b>
$x - n < -m$	$\Delta x_1 = n - x - m; x^- = -m$	$\Delta x_1 = 0; x^- = x - n$
$x + n > m$	$\Delta x_3 = n + x - m; x^+ = m$	$\Delta x_3 = 0; x^+ = x + n$
$y - n < -m$	$\Delta y_3 = n - y - m; y^- = -m$	$\Delta y_3 = 0; y^- = y - n$
$y + n > m$	$\Delta y_1 = n + y - m; y^+ = m$	$\Delta y_1 = 0; y^+ = y + n$

$$\Delta x_2 = x^+ - x^- . \quad (2)$$

$$\Delta y_2 = y^+ - y^- . \quad (3)$$

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